

TAXATION AND THE VANISHING LABOR MARKET IN THE AGE OF AI

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I. Introduction

Economics is reputed to be the dismal science.¹ In that spirit, this essay will focus on a fundamental dilemma for taxation that I anticipate will be generated by future progress in artificial intelligence.

In 1983, Economics Nobel Laureate Wassily Leontief posited:

“The role of humans as the most important factor of production is bound to diminish—in the same way that the role of horses in agricultural production was first diminished and then eliminated by the introduction of tractors.”²

Leontief expressed a concern that has become increasingly common in recent years – that technological progress may make human labor redundant.

The associated dilemma is that labor represents the most important source of income for individual human beings on the one hand and tax revenue for the government on the other hand. If the predictions made by Leontief, and in recent years by an increasing number of technologists, come true, then a large number of people, and perhaps all humans, will lose their jobs to technology at some point in the future.³ If we do not want to let them suffer the natural fate of hunger and starvation, governments around the world will have a much greater need for tax revenue. Yet, at the same time, the most important source of tax revenue is the taxation of labor, which will no longer be possible if human jobs cease to exist.⁴ A succinct way of putting the

¹ Robert Dixon, *The Origin of the Term “Dismal Science” to Describe Economics*, 1999 UNIVERSITY OF MELBOURNE DEPARTMENT OF ECONOMICS 715.

² Wassily Leontief, *National Perspective: The Definition of Problem and Opportunity*, in THE LONG-TERM IMPACT OF TECHNOLOGY ON EMPLOYMENT AND UNEMPLOYMENT 3-4 (Nat’l Acad. Press 1983).

³ NICK BOSTROM, *SUPERINTELLIGENCE: PATHS, DANGERS, STRATEGIES* (Oxford Univ. Press 1st ed. 2014).

⁴ CENT. ON BUDGET & POLICY PRIORITIES, *Where Do Federal Tax Revenues Come From?* (Sept. 28, 2019), <https://www.cbpp.org/research/federal-tax/policy-basics-where-do-federal-tax-revenues-come-from> [https://perma.cc/SD33-NMTF].

fundamental dilemma of taxation in the Age of AI is that as the need for taxation rises, the ease of taxation declines.

In the following sections, I will start by discussing in more detail what it means for human labor to become economically redundant. Then I will describe how economic theories of taxation need to be updated if we move towards a world in which labor becomes redundant. Finally, I will analyze what we should levy taxes on if the taxation of labor is no longer an option.

II. A Thought Experiment: The Vanishing Labor Market

To better understand the critical problem of a contracting labor market, it is useful to focus on an extreme scenario: what should the government tax in a world where human labor has become completely redundant? For our purposes here, let us define human labor as “redundant” when the marginal product of human labor, i.e. the additional output that an additional worker would produce, is below the human subsistence level, i.e. below the cost of human upkeep – the cost of the food, shelter, and medicine that a worker requires to survive.⁵ To be more specific, if a human needs to eat at least 1500 kcal/day to stay alive, but the value of labor—even for the most educated humans – is only enough to afford a 500 kcal/day diet, then human labor is redundant according to our definition. Some may say that even in a world where labor is dominated by AI, (i.e. in which AI can do everything better than humans can) people could still pose as statues in the homes of Jeff Bezos or Mark Zuckerberg. However, given the low economic value that such activities generate, the associated market wage may well be below the cost of human upkeep.

At the time of writing in 2019, human labor is clearly not redundant – in fact, unemployment is at the lowest point in half a century.⁶

⁵ ANTON KORINEK & JOSEPH E. STIGLITZ, *Artificial Intelligence and Its Implications for Income Distribution and Unemployment*, in THE ECONOMICS OF ARTIFICIAL INTELLIGENCE: AN AGENDA 349 (Ajay Agrawal et. al. eds., 2019).

⁶ BUREAU OF LABOR STATISTICS, UNEMPLOYMENT RATE, LABOR FORCE STATISTICS FROM THE CURRENT POPULATION SURVEY, <https://data.bls.gov/timeseries/LNS14000000> (last visited Oct 10, 2019).

However, our scenario is useful to consider because it is the direction in which technological progress seems to be moving. Furthermore, some subgroups of the population may already be technologically redundant – leading, for example, to widespread “deaths of despair.”⁷ Furthermore, current progress in AI is starting to affect workers on the higher rungs of the skill distribution.⁸ And a majority of experts predict human-level general intelligence that can substitute for any tasks performed by humans may only be a few decades away.⁹

If we arrive at a world in which labor markets simply vanish, what are the choices faced by society? There is a wide range of options to deal with this hypothetical scenario, covering a continuum of policy choices. On one end of this continuum, some suggest the government could tax most or all of the income generated by AI and robots and distribute it, ushering in an egalitarian utopia – an era of unprecedented shared human prosperity.¹⁰ In this case, the question of how to tax the income generated in order to distribute it across society is most urgent. On the other end of the continuum is a rather dystopian scenario where humans are left to fend for themselves and will suffer and starve when they can no longer earn their upkeep. In that case, raising taxes would not be particularly important. There is a wide range of options in between these two extremes, and we as a society, whether it is through an intentional political process or through random historical accident, will determine where we end up.

Whereas the question we just posed concerned society’s choices for the future, recent history provides us with examples of how society has tended to treat the losers of technological progress in the past—and the

⁷ Anne Case & Angus Deaton, *Rising Morbidity and Mortality in Midlife among White Non-Hispanic Americans in the 21st Century*, 112 PROC. OF THE NAT’L ACAD. OF SCI. 5078, 5078 (2015).

⁸ David Deming, *AI and Robots are Displacing Science and Tech Workers. The Question is: How Quickly?*, PBS: News Hour (Sept. 28, 2019, 3:56 PM), <https://www.pbs.org/newshour/economy/making-sense/ai-and-robots-are-displacing-science-and-tech-jobs-the-question-is-how-quickly> [https://perma.cc/C7PB-84NE.]

⁹ BOSTROM, *supra* note 3, at 19.

¹⁰ Scott A. Wolla, *Will Robots Take Our Jobs?*, FED. RES. BANK OF ST. LOUIS: PAGE ONE ECON. (JAN. 2018), <https://research.stlouisfed.org/publications/page1-econ/2018/01/02/will-robots-take-our-jobs#> [https://perma.cc/HN4L-2TFN].

picture is not particularly encouraging. For instance, in the past four decades, unskilled labor in the U.S. lost out not only in relative terms, but also in absolute terms.¹¹ An unskilled worker today actually has lower real income than 40 years ago.¹² An idealist would expect that governmental programs would, in response, support those workers who have lost ground due to technological progress. But in fact, over the past four decades, as labor has been devalued economically, political forces have reinforced the downward trend for unskilled worker: our tax system has become less progressive,¹³ and distributive policies have become less generous and have made it harder for unskilled workers to make a living on their income.¹⁴ These facts are evidence that historically, our society has not been very good at countering adverse effects of technological change on workers.

III. Updating Economic Views on Optimal Taxation

One of the main questions in public economics is how we should best design tax systems in order to raise the tax revenue required to meet society's public spending objectives. I will argue that economists' framework for designing tax systems will require some fundamental rethinking in the Age of AI. In particular, if AI progressively devalues human labor, I will show that there are strong economic efficiency reasons to stop taxing human labor, even before labor is fully redundant.

The two main economic factors when designing a tax system are, on the one hand, minimizing efficiency losses and, on the other hand, achieving a desirable distribution of income.¹⁵ Taxes are efficient if they minimize the distortions that they create, for example by minimizing negative incentive effects. When it comes to the question

¹¹ ANTON KORINEK, LABOR IN THE AGE OF AUTOMATION AND ARTIFICIAL INTELLIGENCE, ECONOMISTS FOR INCLUSIVE PROSPERITY 2-3 (Jan. 2019), <https://econfip.org/wp-content/uploads/2019/02/6.Labor-in-the-Age-of-Automation-and-Artificial-Intelligence.pdf>.

¹² *Id.* at 1.

¹³ Thomas Piketty & Emmanuel Saez, *How Progressive is the U.S. Federal Tax System? A Historical and International Perspective*, 21 J. OF ECON. PERSPECTIVES 3, 3 (2007).

¹⁴ Marianne P. Bitler & Hilary W. Hoynes, *The State of the Social Safety Net in the Post-Welfare Reform Era*, BROOKINGS PAPERS ON ECON. ACTIVITY 71 (2010).

¹⁵ ANTHONY ATKESON & JOSEPH STIGLITZ, LECTURES ON PUBLIC ECONOMICS 7 (1980).

of distribution, the objective is to generate a distribution of resources among members of society that is in line with society's preferences on inequality, for example by imposing a larger tax burden on those who can afford to pay more. Depending on one's political preferences that may mean flat taxes that affect everyone equally, or it may mean tax rates in excess of 80% on billionaires, as suggested by the French economist Thomas Piketty.¹⁶ The two objectives of maximizing efficiency and obtaining an equitable distribution of resources are frequently in conflict with each other.

a. The Economics of Capital Taxation

One of the most surprising, and simultaneously most instructive, theorems in the economics of optimal taxation is that it is optimal *not* to impose any taxes on capital in the long-run, no matter if we care mostly about efficiency or mostly about inequality.^{17,18} Like every economic theorem, the result rests on assumptions that are never fully satisfied in practice, but there are nonetheless important lessons to learn from it.¹⁹ The intuition behind the result is that capital is an intermediate good. Capital is not something we directly consume, but it is used to produce future consumption goods. If the government taxes capital, it discourages its accumulation, leads to a decline in the capital stock, and makes the production of consumption goods more difficult. Consequently, the government should not tax capital, the intermediate good, in the long run – this would ultimately just make everybody worse off, including the workers that the taxes are supposed to support. Instead, the standard theory of optimal taxation suggests that the government should tax either consumption or people's labor income.²⁰ This result is one of the cornerstones of the economics of taxation.

¹⁶ THOMAS PIKETTY, *CAPITAL IN THE TWENTY-FIRST CENTURY* 512-13 (Arthur Goldhammer trans., Belknap Press of Harvard Univ. Press 2014).

¹⁷ CHRISTOPHE CHAMLEY, *Optimal Taxation of Capital Income in General Equilibrium with Infinite Lives*, 54 *ECONOMETRICA* 607, 607 (1986).

¹⁸ KENNETH L. JUDD, *Redistributive Taxation in a Simple Perfect Foresight Model*, 28 *J. PUBLIC ECON.* 59, 81 (1985).

¹⁹ See Ludwig Straub & Ivan Werning, *Positive Long Run Capital Taxation: Chamley-Judd Revisited*, (Nat'l Bureau of Econ. Research, Working Paper No. 20441, 2014).

²⁰ See ATKESON & STIGLITZ, *supra* note 15, at X.

b. Lessons from Capital Taxation for Labor Taxation in the Age of AI

However, recent advances in AI surprisingly suggest that we should apply the same logic to the taxation of labor (i.e. that it is desirable not to impose taxes on labor), as I will elaborate in the following.

In the past few centuries, in the period after the Industrial Revolution, the economy produced so much surplus that the vast majority of workers in advanced countries lived above subsistence levels—i.e. their income was well above what is needed to cover their basic human needs and survive.²¹ During that period, taxes on labor had some effects on an individual's decision to supply labor in the market, but they had little effect on overall population numbers and therefore on the supply of human bodies to the economy.²² Standard economic prescriptions about the taxation of labor are, naturally, based on this world.

Before the Industrial Revolution, by contrast, humanity lived in a Malthusian world. Malthus' critical insight was that throughout much of the history of humanity, any economic growth, whether it stemmed from the discovery of new lands or of new methods of production, led to a proportionate increase in the size of the human population, so that the individual human was back at subsistence levels after the population adjustment.²³ This was a dismal perspective, since, from the perspective of individual well-being, there was no scope for permanent increases in economic well-being.

In a Malthusian world, taxes on human labor reduce take-home incomes below subsistence levels (unless, of course, they are distributed back to the workers from whom they are taken, but in that

²¹ CLARK NARDINELLI, *Industrial Revolution of the Standard of Living*, THE LIBR. OF ECON. AND LIBERTY, <https://www.econlib.org/library/Enc/IndustrialRevolutionandtheStandardofLiving.html> [<https://perma.cc/YNF6-9S84>].

²² *Id.*

²³ THOMAS MALTHUS, AN ESSAY ON THE PRINCIPLE OF POPULATION 6 (Elec. Scholarly Publ'g Project 1998) (1798), <http://www.esp.org/books/malthus/population/malthus.pdf>.

case they do not generate net revenue).²⁴ This leads to starvation and an associated decline in the human population, up to the point where the available resources, after the tax, are sufficient so that the average human obtains a subsistence income yet again.²⁵ In other words, in a Malthusian world, changes in income-net-of-taxes lead to proportionate changes in the size of the human population and in the supply of bodies to the economy.

The reason why humanity escaped this Malthusian world—with the advent of the Industrial Revolution—was that rapid economic progress lifted incomes so fast that population growth could not keep up with economic growth.²⁶ This happened because progress was roughly what economists call Hicks-neutral, meaning the fruits of economic progress were distributed equally between labor and capital. By contrast, if future progress in AI is no longer Hicks-neutral but instead labor-replacing, it may well generate significant declines in human wages. In the limit, this may bring us back to a world where Malthusian dynamics apply to wage earners.²⁷ In that case, our results for labor taxation in a Malthusian world would apply yet again.

Notice the close analogy between the well-known economic theorem on optimal capital taxation and our new results on optimal labor taxation in a Malthusian world: both capital and labor are factors that are expensive to create and maintain. Capital requires economic resources that are used for maintenance and reinvestment. Labor requires economic resources that are used for maintenance and upkeep. In other words, one of the reasons we pay workers is so that they can maintain themselves and provide labor to the economy. Taxing capital discourages the accumulation of capital and ultimately hurts everyone, including the workers.²⁸ Taxing labor discourages the accumulation of

²⁴ *Id.* at 8-9.

²⁵ *Id.*

²⁶ GREGORY CLARK, *A FAREWELL TO ALMS: A BRIEF ECONOMIC HISTORY OF THE WORLD* (Princeton Univ. Press 2007).

²⁷ See Anton Korinek, *The Rise of Artificially Intelligent Agents* (Sept. 2018) (unpublished manuscript), <http://www.korinek.com/download/AIAs.pdf>.

²⁸ Chris Edwards, *Taxing Wealth and Capital Income*, 85 CATO INSTITUTE: TAX & BUDGET BULLETIN 1, 8-10 (Aug. 1, 2019), https://www.cato.org/sites/cato.org/files/pubs/pdf/tbb85_final_edit.pdf.

workers and ultimately hurts everyone, including the capitalists.²⁹ In a way, both capital and labor can be viewed as intermediate goods to produce final output, and it would be grossly inefficient to tax either.

Our line of reasoning is, of course, built on strong assumptions about the effects of future progress in AI on labor markets, but it serves to highlight a stark economic force that may make it increasingly undesirable to impose significant taxes on labor, for pure efficiency reasons—even if we did not care about an equitable distribution of incomes.

IV. Alternative Sources of Tax Revenue

What else can and should be taxed if neither labor nor capital can serve as an efficient source of tax revenue?

Let me first observe that an ideal target for taxation is externalities, on which we can levy Pigouvian taxes and collect revenue while simultaneously increasing economic efficiency. Pigouvian taxes are named after the famous economist Arthur C. Pigou who emphasized, almost a century ago, that when there are negative externalities, taxing those externalities simultaneously makes the market allocation more efficient and raises tax revenue.³⁰ Society can employ the resulting tax revenue in any way it desires. Under Pigouvian taxation, there is thus no conflict between the two goals of efficiency and equitable distribution.³¹ A simple example is the case of environmental externalities, such as pollution. The fundamental problem of negative externalities is that they impose costs on society that their creators do not internalize—the polluter reaps the benefits of an economic activity whereas all of society suffers from the effects of pollution.³² However, if polluters are charged a tax that reflects precisely the costs that their pollution imposes on society, then the tax corrects the incentives to create excessive pollution and makes the economy more efficient

²⁹ *Id.*

³⁰ See generally ARTHUR C. PIGOU, *THE ECONOMICS OF WELFARE* (1932).

³¹ *Id.*

³² Carl J. Dahlman, *The Problem of Externality*, 22 J. L. & ECON. 141, 151 (1979).

while simultaneously raising revenue. As the labor share of income in the economy declines, the share earned by natural resources and, hence, the potential for Pigouvian taxation, may in fact rise.

Another way to identify promising candidates for taxation in the Age of AI is to observe an important insight from economics: technological progress is overall a positive sum game. Whenever one factor of production, for example labor, experiences losses as a result of new technology, the positive-sum nature of technological progress implies that there must be other factors of production that are gaining more than what labor has lost. When considering how to raise tax revenue when the value of labor declines, it is thus natural to look for the winners of technological progress. To put it succinctly, when adjusting our tax system for a post-labor world, we should follow where the money is going. In that spirit, let me discuss three specific winners from technological progress.

The first example are the owners of fixed factors, such as land and certain natural resources. For instance, returns to land, particularly in crowded metropolitan areas such as Silicon Valley and New York City, have skyrocketed in recent decades because technological progress has made the land in these areas more valuable. This makes them a natural candidate to tax. An additional benefit of taxing fixed factors like land is that taxes on such factors cannot distort incentives to supply the factor. For example, if the government taxes land, the tax is unlikely to change people's incentives to produce more land—land is simply fixed (with minor exceptions like New York City and Singapore where people deploy resources to create land). However, it is important to emphasize that a property tax on the structures built upon land would distort incentives to build structures such as housing.³³

The second example of a factor that has really gained from technological progress is skilled labor. This example is very relevant in today's world, though perhaps less so in a future when even highly-

³³ Jeffrey P. Cohen & Cletus C. Coughlin, *An Introduction to Two-Rate Taxation of Land Buildings*, 87 FED. RES. BANK ST. LOUIS 359, 360 (2005).

skilled workers may be made redundant by technological advances. In recent decades, highly-skilled workers have gained to a large extent because technology has increasingly favored skilled over unskilled workers—the economy has had greater use for skill than it used to.³⁴ This has made skilled labor a good target for taxation.

Taxing the winners of technological progress, such as land or skilled labor, naturally presents the political economy problem that the winners do not like to give up their gains. Whereas the losers of technological progress like to argue that they are the victims of broader external forces, the winners of progress like to argue that all their gains are well-earned by their efforts and hard work. This may be true to some extent—the winners may have, for example, done more extensive research on which factors will gain and which factors will lose. This type of research would be disincentivized if the prospective winners anticipate that their gains will be taxed away, reducing, for example, incentives to invest in the right types of human capital. However, there is also always an important element of chance in determining which technological changes occur and how they affect the distribution of income, justifying at least some taxation on the winners of progress.

The third example of a “factor” that has gained significantly in recent decades is monopoly power. Monopoly rents have seen a large rise in their share of income in the US, in part, at the expense of labor.³⁵ At times, monopoly rents can be taxed without introducing economic distortions in the economy since they are pure rents. However, there is also an important qualification to this observation, which arises when monopoly rents are used to cover fixed costs such as research and development -- which we will discuss in the following.

³⁴ LAWRENCE KATZ & KEVIN MURPHY, *Changes in Relative Wages, 1963-1987: Supply and Demand Factors*, 107 Q. J. ECON. 35, 54 (1992).

³⁵ Jan De Loecker & Jan Eeckhout, *The Rise of Market Power and the Macroeconomic Implications* (NAT'L BUREAU OF ECON. RESEARCH, WORKING PAPER No. 23687, 2017), <https://www.nber.org/papers/w23687.pdf>.

V. Digitization and Rents in an Information Economy

The last case I would like to discuss is the taxation of the digital economy. This requires that we observe that information goods differ fundamentally from more traditional goods in the economy: they are non-rivalrous, which carries crucial implications for market structure and taxation.³⁶ If a good is rivalrous, it can be used only by one person at a time, like for example a chair. By contrast, information can be used by many people at once without being diminished. In fact, everybody around the world can use a given piece of information without diminishing it.

Even though information is non-rivalrous, however, it is potentially excludable, and intellectual property law has made the use of many information goods legally excludable. Intellectual property rights allow the creators or owners of information goods to exclude others from using them. As a result, the owners of information have monopoly power in the economic sense of the word, which gives them the ability to extract information rents.

This ability to collect information rents in turn carries both positive and negative implications. The positive side is that the information rents provide incentives for the creation of information goods and allow their creators to cover the costs of producing them. Many information goods (e.g., software) require large upfront fixed costs. It would be impossible to finance the creation of information goods in a perfectly competitive market, since such a market would always pay the marginal cost of providing the goods to an additional person, which is close to zero—the marginal cost curve is below the average cost curve for any quantity produced. Information goods are thus fundamentally incompatible with efficient markets in the traditional sense and require some monopoly power if produced in a market setting.

³⁶ ANTON KORINEK & DING XUAN NG, *DIGITIZATION AND THE MACRO-ECONOMICS OF SUPERSTARS* (University of Virginia 2018).

The downside of monopoly power over information goods, however, is that the associated monopoly rents inefficiently limit the use of the information goods. Since private companies need to charge for the information goods even though the marginal cost of the goods is zero, their distribution is inefficiently limited. In many cases, the monopoly rents earned by companies in the information economy are arguably in large excess of the costs of producing the information goods. The resulting rents are then clear targets for taxation. Potential inventors continue to have incentives to work on their inventions as long as they can expect to make profits after subtracting the costs of creating information goods and any taxes. If information rents stem from intellectual property rights, then an alternative strategy to taxation to reduce any excess rents on information goods is to weaken IP rights.³⁷

VI. Application To Robot Taxation

Consider the taxation of rents in one specific context: the taxation of robots. A significant part of the value of robots is comprised of their design and programming, both of which are information goods and are non-rivalrous. As a consequence, the observations above about the taxation of information goods apply to this part of robots. By contrast, the physical vessel of the robot constitutes physical capital in the traditional sense, and our earlier discussion on the desirability not to tax capital applies to that part. In summary, we should refrain from taxing the robot as a physical vessel but should tax the design of the robot and the programs that are running on it because those are information goods that generate rents.

VII. Conclusion

A final point observation is that the direction of technological progress is not just driven by blind technological forces but is a societal choice which can be shaped, among many other factors, by tax policy.³⁸

³⁷ Korinek & Stiglitz, *supra* note 5, at 352.

³⁸ See generally Anton Korinek, *Integrating Ethical Values and Economic Value to Steer Progress in Artificial Intelligence*, in OXFORD HANDBOOK ON THE ETHICS OF AI (Markus D. Dubber et. al. eds., 2019).

Advances in AI can be directed in two different directions: AI can be advanced such that it replaces workers, or AI can be advanced such that it empowers workers and makes them more productive. Currently, high labor taxes encourage entrepreneurs to develop labor-replacing AI rather than labor-enhancing AI. This is accelerating the arrival of a time when labor will be largely displaced.

In summary, from this particular economist's perspective, advances in AI should make governments more and more cautious about continuing to impose significant tax burdens on labor. They should also be cautious about taxing *physical* capital (with emphasis on the qualifier physical). However governments should and probably will have to increasingly focus on taxing fixed factors, externalities and rents, especially in the context of monopolies